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ABSTRACT

Teacher education reform policies and proposals--particularly those of the Holmes Group--call for fewer education courses and more liberal arts. This paper examines the assumptions that underlie such proposals. A review of recent research on teaching and learning in undergraduate physics and mathematics raises questions about the effectiveness of undergraduate instruction in challenging fundamental ideas and beliefs and helping students develop meaningful, connected understandings. Questions are raised about the role that recent ideas about cognition play in teaching liberal arts. Recent reports on undergraduate education that portray teaching as frequently unchallenging offer little hope of change: The reward structure of higher education is unlikely to change to encourage more attention to teaching. The various liberal arts disciplines provide scholars little incentive to think about, much less inquire into, teaching their field. In the culture of higher education, scholars' prerogatives to teach what they individually consider important tends to take precedence over concerns for the perceived coherence of programs of study. (Author/JD)

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G. Williamson McDiarmid

NCRTE

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WHAT DO PROSPECTIVE TEACHERS LEARN IN THEIR LIBERAL ARTS COURSES?

G. Williamson McDiarmid

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Abstract

Teacher education reform policies and proposals--particularly those of the Holmes Group--call for fewer education courses and more liberal arts. This paper examines the assumptions that underlie such proposals. Specifically, the author questions the assumption that more subject matter courses produce greater knowledge of the kind that teachers need in order to help students understand the content. Reviewing recent research on teaching and learning in undergraduate physics and mathematics, the author raises questions about the effectiveness of undergraduate instruction in challenging fundamental ideas and beliefs and helping students develop meaningful, connected understandings. Such understandings are necessary if teachers are to help pupils in schools develop similar understandings of subject matter.

He further raises the questions about the role that recent ideas about cognition play in teaching the liberal arts. Recent reports on undergraduate education that portray teaching as frequently unchallenging offer little hope of change: The reward structure of higher education is unlikely to change to encourage more attention to teaching. The various liberal arts disciplines, moreover, provide scholars little incentive to think about, much less inquire into, teaching their field. Finally, in the culture of higher education, scholars' prerogative to teach what they individually consider important tends to take precedence over concerns for the perceived coherence of programs of study.

Given such conditions, the chances that the pedagogy of the liberal arts will change substantially seem slim. Without such changes, the hoped-for developments in prospective teachers' knowledge seem unlikely. By raising hopes that depend for their fulfillment in part on liberal arts faculty, reformers may be unwittingly setting themselves up for yet more criticism from policymakers if the reforms produce little change in what happens in school classrooms.

WHAT DO PROSPECTIVE TEACHERS LEARN IN THEIR LIBERAL ARTS COURSES?[1]

G. Williamson McDiarmid[2]

In *Tomorrow's Teachers*, the Holmes Group recommends abolishing undergraduate majors in education and moving professional teacher preparation to the graduate level, thereby increasing the number of liberal arts classes prospective teachers take (Holmes Group, 1986). California, New Jersey, Virginia, Texas, and Illinois are among the states that have anticipated such reforms, eliminating or limiting education courses for prospective teacher. If more liberal arts is considered better, at least by the authors of *Tomorrow's Teachers* and policymakers in some states, what do we know about what undergraduates learn in these courses?

While important for all students, the question of the knowledge undergraduates have the opportunity to learn and what they make of these opportunities in their liberal arts courses is especially critical for prospective teachers. In principle, liberal arts courses constitute a rich source of knowledge on which teachers could draw when they teach. In addition to being a potential source of substantive knowledge, liberal arts courses are sources of other kinds of knowledge--about, for example, what it means to "do" mathematics, literary criticism, physics, or history; about what counts as knowledge in these disciplines; about teaching and learning specific subjects; and, more generally, about learners and learning. While few liberal arts faculty appear to think of themselves as pedagogical models, they nonetheless represent, by their actions, their conceptions of disciplinary knowledge, its relationship to other bodies of knowledge, and how this knowledge is taught and learned. Faculty do this through their syllabus, the texts and paper topics they assign, the discourse they encourage and activities they organize in their classes, and the evidence they accept of learning. As they do in precollege classrooms, students in college classrooms learn from the hidden as well as the official curriculum (Jackson, 1968).

In this essay, I first discuss what teachers need to know if they are to help students learn subject matter in ways that allow them to see connections within and between the disciplines, between the subject matter and the world beyond school, and, most importantly, between their lives and the subject matter. Without such understandings, students are unlikely to progress beyond mechanical knowledge in any field. To explore the likelihood that prospective teachers can learn at least part of what they need to know in their liberal arts courses, I then review what investigators have found out about learning in various liberal arts subjects. Finally, I--speculate on the fate of the proposed reforms, given what is known about learning in specific subjects and, more generally, about the state of teaching and

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[1]To be published in *Theory Into Practice*.

[2]G. Williamson McDiarmid, associate professor of teacher education at Michigan State University, is associate director of the National Center for Research on Teacher Education. Deborah L. Ball, David K. Cohen, Robert Floden, and Mary K. Kennedy provided thoughtful comments on earlier drafts of this paper.

learning in the liberal arts. Reform in education, however well intended, has a depressing tendency to generate, perversely, new problems. Highly publicized reforms that fail to deliver could provide policymakers with pretexts, if any are needed, to assume greater control over teacher preparation.

Dimensions of Subject Matter Knowledge for Teaching[3]

What do teachers need to know about subject matter in order to teach it? Subject matter knowledge is conventionally thought to consist of the facts, ideas, theories, explanations, and procedures in a given field of inquiry. While critical for teaching, such *substantive knowledge* constitutes but one dimension of subject matter. Teachers, intentionally or not, also convey to students what a subject is about: Teachers may portray history as a more or less sequential narrative and in so doing convey that the account they relate is the only one. Teachers who understand history differently, understand it as an argument about the meaning of past events and developments, may present more than one story about the past, conveying the interpretive nature of historical scholarship.

Similarly, by what they do, teachers, as representatives of their discipline, also communicate what specialists in the field do. Teachers who rely exclusively on the textbook in teaching may confirm for students that historians read and remember written texts--and, in the students' experience, what historians read is frequently boring and seemingly unconnected to anything outside itself (Gagnon, 1988). Historians, however, do history in a variety of ways and settings: Mark Bloch (1954) took to the air to plot land-use patterns in rural France to enhance understanding of the economy and society of France in the middle ages; Samuel Eliot Morrison (1978) set sail in the Atlantic to trace the routes of early explorers; Henry Adams (1925) pounded the cold granite of France's great cathedrals to try to comprehend the power of the Virgin; Theodore White (1961;1965;1969) endured the pace and pinch of presidential campaigns to document and investigate American electioneering. Teachers who understand that "doing" history is varied and, occasionally, exciting convey to students perspectives that differ considerably from the stereotype of the tweedy, fuzzy-headed, myopic historian tunneling ever deeper in the library stacks in search of arcane documents. Failure to address students' stereotypes of mathematicians, historians, writers, and scientists is tantamount to confirming such misconceptions.

Teachers also communicate something to their students about the nature of knowledge in their field. Is knowledge fixed and agreed upon or is it subject to revision and dispute? Teachers may portray mathematics as a body of rules and procedures that must be learned and remembered. Alternatively, teachers who understand the nature of mathematics differently may convey the idea that mathematics is a field in which the experts disagree, in which understandings continue to grow and change. Teachers may communicate--implicitly--that a particular historical account is "true" rather than an attempt to make sense

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[3]This section draws on Ball and McDiarmid (in press).

of the past based on a body of evidence, the intellectual framework of the historian, and the historian's rhetorical intent.

Finally, teachers convey to students the meaning of teaching and learning the subject. History teachers who require students to read the textbook, attend to lectures, and reproduce selected bits of substantive knowledge on multiple-choice tests communicate something quite different from teachers who involve students in evaluating the evidence for alternative interpretations, invite debate among students, challenge textual accounts of the past, and ask students to talk and write about their understandings of how historical events are related.

The kind of teaching that proponents of the Holmes Group reforms envision would draw on all these dimensions of subject matter knowledge. Such multidimensional understanding of subject matter is, however, unlikely to come from intending teachers' precollegiate education or from the wider culture (Ball and McDiarmid, in press; Cohen, 1988; Powell, Farrar, and Cohen, 1985). Teachers might also learn about these dimensions of subject matter knowledge from their own practice. The experience of coming to understand, for example, the division of fractions or the causes of the American Civil War while actually teaching is probably fairly common. Yet, neither teachers themselves nor those who study teaching appear to have written enough about such subject matter epiphanies to determine what teachers learn from them or the conditions that produce them. If prospective teachers do not derive such multidimensional understandings of subject matter from precollegiate schooling nor from the wider culture and if we are as yet unsure about what understandings teachers glean from teaching, do such understandings develop in their liberal arts studies?

Learning About Subject Matter From Liberal Arts

Research on students' substantive knowledge in specific subject matter fields and on their understanding of the nature of knowledge in specific fields is--as this essay will show--spotty and unsystematic. Like most research at the elementary and secondary level, research on teaching and learning in college has focused on generally effective teaching techniques--such as wait time and good questioning strategies--and on comparisons between lectures and alternatives to lecturing rather than on teaching and learning information, procedures, principles, ideas, and concepts in specific disciplines (for reviews, see Dunkin and Barnes, 1986; McKeachie, Pintrich, Lin, and Smith, 1986; Kulik and Kulik, 1979).

The little that we know about student understanding of specific subject matter is troubling. The two subject matter areas in which researchers have studied both what undergraduates are taught and what they actually learn are physics and mathematics. Those who teach undergraduate physics have been puzzled for years by recurring student misunderstandings about mechanics. Physics students--even those in their second physics course--persist in believing that constant motion requires a constant force, in the face of numerous examples to the contrary; that is, they believe that for an object such as a pendulum to remain in motion, it must be acted upon by a constant force that causes and

sustains the motion. Through interviews, researchers have determined that students tend to draw on their own experience of the physical world in developing an implicit theory about bodies in motion. Apparently, in many physics classrooms, neither the textbook nor the instructor confronted such "naive schemata" directly (Champagne, Gunstone, and Klopfer, 1985). (When instructors subsequently developed representations of motion, velocity, and acceleration that elicited and directly addressed students' naive conceptions, students could compare their implicit theories with physicists' understandings of motion and force. See McDermott, 1984, for a review of research on undergraduates' naive theories and common misconceptions in mechanics; see Champagne, Gunstone, and Klopfer, 1985, for an example of instruction that targets specific misunderstandings in mechanics.)

In mathematics, research on students' understanding has produced similar findings. A number of studies in this decade (Clement, Lochhead, and Monk, 1981; Clement, 1982; Maestre, Gerace, and Lochhead, 1982; Maestre and Lochhead, 1983) have demonstrated the inability of undergraduates majoring in science and engineering to represent correctly a simple algebraic relationship between two variables--to wit, the famous "student-professor" problem:

> Write an equation using the variables S and P to represent the following statement: "There are six times as many students as professors at this university." Use S for the number of students and P for the number of professors. (Maestre and Lochhead, 1983, p. 181)

Typically, students who offer an incorrect equation reverse the variables: $6S = P$. Clement and his colleagues (1981) report that over one-third of the engineering students they tested and nearly 6 out of 10 nonscience majors could not offer an appropriate representation. Ball (1988) reports that whereas mathematics majors planning to teach produced more correct answers for division involving fractions, zero, and algebraic equations than did elementary education majors, the math majors frequently struggled in "making sense of division with fractions, connecting mathematics to the real world, and coming up with explanations that go beyond restatement of the rules" (p. 39). Schoenfeld (1985) reports on the difficulties his undergraduates, most of whom had previously done well in college calculus as well as in secondary school geometry, encounter trying to explain even simple geometric problems: "My class spent a week (at the college level) uncovering the reasons for two constructions that they had been able to produce from memory in less than two minutes" (p. 376). McDiarmid (1989a) reports on the struggles of his beginning teacher education students, some of whom had been successful in college calculus, to explain why $-6 - (-4) = -2$.

In both physics and mathematics, evidence is mounting that few students, whether prospective teachers or not, develop a conceptual understanding of the subject matter. The lack of such understanding seriously inhibits teachers' capacities to help pupils understand

the knowledge they encounter in schools (Ball and McDiarmid, in press). In history and composition, researchers seem to have paid less attention to undergraduates' difficulties with the conceptual foundations of these fields. Commentators advocate various positions for what should be included in the study of the subject rather than addressing learners and their understandings. As Bartholomae (1980) has written of students in basic college writing courses, "We know little about their performance as writers, beyond the bald fact that they fail to do what other, conventionally successful writers do" (p. 253).

In research on writing instruction, some exceptions exist, such as Coleman's (1984) ethnographic study of five undergraduates in her basic writing course. Through the use of specific pedagogical devices such as learning logs and peer response groups, she both documents and facilitates her students' evolution from writers who viewed revision as fixing mistakes to writers who conceived of revision as clarifying their meaning. Building on Perry's (1970) conjectured epistemological development of college students as his theoretical frame, Ryan (1984) found that college students who believe that knowledge is "an array of interpreted and integrated propositions"--as opposed to "an unorganized set of discrete and absolute truths"--are more likely to produce coherent written text. In these studies, the researchers have examined college students' conceptions as a basis for thinking about instruction. Research of this type parallels the earlier work of Britton and his colleagues (Britton, Burgess, Martin, McLeod, and Rosen, 1975) who found that precollege students write for their teachers with the purpose of reporting what they know.

Apparently, little research has been conducted on college students' understanding of history. Nicholls (1984), on the basis of questionnaires completed by eight history teachers from colleges, polytechnics, and universities in Britain who taught at American colleges under the Fulbright program, summarized his respondents' views on the pedagogy of history:

> History courses were perceived as being organized around a lecture program and an accompanying text, with these two vehicles assuming excessive weight in the overall scheme of things, while the information thus imparted was later "retrieved" by some "objective" test to measure just how much of it the excessively grade-conscious student had ingested. (p. 65)

O'Brien (1984) describes an intriguing American history survey course he taught that involved community college students in making their own sense of historical "moments" while he provided data and guidance. He fails, however, to report sufficient information on student learning to assess his approach. Absent from the literature are investigations of differences in learners' understandings of critical historical concepts such as causation, sequence, and development; "their notions of what doing history means"; and their ideas about what "knowing history" means.

Students' encounters with the disciplines in liberal arts courses help shape their notions about the *nature* of the subject matter, their disposition to think about and find out

more about ideas in a given field, as well as their concepts of how a given topic is best taught and learned. Imagine the difference between prospective teachers who experience history as an argument about what happened in the past and why, and those who encounter history as what is represented in a textbook. And yet, with the exception of the studies reported above, researchers tend to ignore what college students construct of the knowledge they encounter, focusing instead on "the static aspects of the propositional structure of declarative knowledge" in various disciplines (McKeachie, Pintrich, Lin, and Smith, 1986, p. 21) or instructional issues, such as the relative advantages of lecture or discussion approaches to teaching (see Dunkin and Barnes, 1986; Kulik and Kulik, 1979). As a result, far too little is known about what prospective teachers learn from their college study of specific disciplines. The research that has been done, however, should urge caution in assuming that prospective teachers develop connected conceptual understanding of subject matter in their liberal arts courses.

Learning About Learners and Learning

Research on learning increasingly highlights the role of learners' initial understandings (Resnick, 1983; Wittrock, 1986). Teaching for understanding requires creating opportunities for students to manifest their initial conception, understanding, or values. Like most people, students have no reason to think about their ideas or values as long as they seem to work. As lecturing appears to dominate instruction at the university level as it does at the secondary level, students rarely are forced to state, much less to examine, defend, or justify their beliefs or ideas. Consequently, while they may remember what a lecturer has said in order to pass a test, the information they commit to short-term memory may not alter their own framework for making sense of the world, of themselves, and of others. Their deeply rooted beliefs and conceptions--be they about moving objects or "the good"--remain untouched by the words of text or teacher.

Undergraduates navigate their social and physical world more or less successfully for many years before they take college courses. In so doing, they develop and organize, through interactions with others and through their direct contact with the world, ideas about how things work--relationships with others, the growth of plants, the motion of objects, the unfolding of events in the world, social institutions like prisons and schools, and so on. They also develop and organize moral concepts--about responsibilities, about good and bad, about what's important and what isn't. Teachers ignore learners' initial understandings and knowledge at their own peril, as the example of learning mechanics noted above illustrates. Learning, we are discovering, consists not in developing undeveloped faculties or filling in heretofore vacant mental lots:

> [People] do not simply acquire information passively until there is enough of it for 'correct' rules and explanations to emerge. This tendency to construct

> ordered explanations and routines even in the absence of adequate information can account at least partly for another phenomenon . . . : robust beliefs that are resistant to change even when instruction (and thus better information) *does* come along. (Resnick, 1983, p. 26)

In learning, students act upon the information, ideas, and experiences they encounter within and through the structured and ordered understandings and knowledge they have from previous experiences and within and through specific social contexts. To extract meaning from experience, people rely on understandings built on previous experiences and on their social context.

Students make their own sense out of what they encounter in formal instructional settings. They do this by relating what they are encountering with what they have previously encountered; that is, learning that is meaningful to the learner is *relational*--relating new ideas or ways of thinking or values to already existing ones and to those in the learner's context. Students' prior knowledge may either facilitate their understanding new information or concepts or it may interfere with such understanding (Duckworth, 1979). Teachers who want students to understand what they are learning, who want to change the frames students use to understand what they encounter, are concerned with representing the subject matter in ways that take into account students' existing knowledge (McDiarmid, Ball, and Anderson, 1989).

This may involve representations that link up with students' prior experience--or deliberately create discontinuities in students' experience (Floden, Buchmann, and Schwille, 1987; McDiarmid, 1989b). In assessing existing representations or in developing new ones, teachers must know and think about their students' understandings as well as the subject matter. Most college teachers appear to be interested in representations faithful to the subject matter alone and seemingly pay scant attention to students' existing or evolving understandings and values.

For prospective teachers, the lack of attention to learners' background and initial understandings they encounter in many of their liberal arts classes communicates that knowledge of subject matter alone is sufficient for teaching. Rarely do undergraduates encounter in their classes representations of the subject matter that take into account the background and knowledge of specific groups of learners. How frequently, for instance, do college faculty engage undergraduates in discussions of historical causation or the nature of zero or the behavior of moving objects to find out how the students make sense of the these phenomena? If prospective teachers are to include considerations of learners' initial understandings in their teaching, they require more than an admonition to do so. They need to see how this is done in specific subject matter areas because the learners' conceptions that are most salient in teaching will vary with the subject matter (McDiarmid, Ball, and Anderson, 1989).

Understanding the Pedagogy of the Liberal Arts

In his recent study of undergraduate education, Boyer (1987) is less than flattering in portraying the teaching that he and his colleagues observed in the stratified sample of 29 colleges and universities they visited around the country.

> With few exceptions, when we visited classes, the teacher stood in front of rows of chairs and talked most of the forty-five or fifty minutes. Information was presented that often students passively received. There was little opportunity for positions to be clarified or ideas challenged. (p. 150)

When considered together with the evidence on learning in liberal arts courses, Boyer's observation raises troubling questions about replacing education courses with additional liberal arts classes as a way to improve prospective teachers' academic preparation.

Other recent examinations of liberal education raise additional concerns (for a review of reports on undergraduate education, see Kimball, 1988). Kimball (1986) portrays undergraduate education as caught in a cross fire between two competing traditions of liberal arts. The tradition he believes has gained ascendancy in U. S. colleges he describes as follows: "In the liberal-free ideal, skeptical doubt undermines all certainty, casting individuals entirely upon their own intellect for judgments that can never finally be proven true" (p. 219). With little agreement among faculty even with the same discipline on a core body of essential knowledge, the undergraduate liberal arts experience has become increasingly fragmented. Exercising their academic freedom and, critics such as Kimball charge, indulging their license to inquire, faculty teach whatever they like with little or no regard for the totality of students' educational experience. Bloom (1987) concurs: His gloomy assessment of contemporary liberal education proceeds from his judgment that the relativism rampant in college classrooms has undermined shared values and agreement on a body of essential knowledge.

If Kimball and Bloom are correct in asserting that, among faculty, individually determined inquiry, course content, and pedagogy are the dominant norms, the knowledge taught in liberal arts programs seems an unlikely candidate for the kind of reconsideration the Holmes Group urges. As we have seen, liberal arts courses as currently organized and taught are unlikely to help prospective teachers develop the kinds of knowledge of subject matter essential to teaching for understanding. Consequently, to be successful, the proposed reforms depend heavily on an even broader reformation--of pedagogy in the liberal arts.

The prospects for such a reform do not seem bright. As Boyer (1987) points out, the promotion and tenure system does little to encourage attention to teaching, rewarding research and publication rather than good pedagogy. Faculty receive little or no preparation for teaching beyond their own "apprenticeship of observation," thereby ensuring the

perpetuation of a certain pedagogy. Graduate training, focused on problems and topics narrowly defined and often conservatively pursued, produce specialists "whose teaching is often lifeless, stilted, and pedestrian" (Bennett, 1984, p. 17). Such specialization ill prepares, in particular, instructors called upon to teach introductory courses intended to provide a broad, coherent view of a field (Bennett, 1984).

Understandably, many faculty gear their teaching to those undergraduates who are majoring in the discipline and may be the graduate students of tomorrow--that is, those students most like themselves. Moreover, they do not make rewarding careers for themselves by thinking, writing, or talking about the kinds of knowledge that teachers need to help pupils in school understand subject matter in meaningful, connected ways. Rather, recognition comes from piling one's own brick on the edifice of substantive knowledge. Kimball (1988) quotes Stephen Jay Gould and Daniel Bell, academicians of some repute and influence, who caution against "overly romanticizing" (p. 318) teaching and who assert that it does not (at least at Harvard) and *should* not play a major role in the reward system.

Kimball (1988) has identified two impediments to a reconsideration of pedagogy in liberal arts courses, one ethical, the other institutional: That faculty should be free to teach whatever they deem most important without regard to other knowledge students have the opportunity to learn is the ethical issue. Institutionally, the need to balance the "political interests of entrenched departments" explains, in part, why debates over critical knowledge are subsumed to reckoning the number of student credit hours a given unit needs to maintain or increase its resources. Boyer (1987) suggests a third: The relatively low priority that the reward structure of universities places on good undergraduate teaching. The analysis here highlights a fourth: Within their disciplinary fields, liberal arts faculty have no incentive to consider the kinds of epistemological issues that must be addressed if undergraduate pedagogy is to encompass the needs not merely of intending teachers but those of all students.

So what is to encourage liberal arts faculty to think of their role as teacher educators? Currently, little more than their individual commitments to such a role. Yet, the kind of understanding that teachers need may in fact be the kind of understanding that all undergraduates require. Kimball (1988), Bloom (1987), Boyer (1987), Bennett (1984) and others have criticized the lack of integration and coherence in liberal arts programs. We can also imagine that these qualities are similarly absent at the level of individual courses and the major. Any reconsideration should include, therefore, the subject matter understandings that all students, not merely prospective teachers, have the opportunity to develop in the liberal arts.

If this portrait of knowledge and pedagogy in undergraduate education and of the prevailing values among liberal arts faculty is accurate, teacher educators need to look carefully at the reforms proposed by the Holmes Group. Without concomitant reforms in teaching and learning in the liberal arts, the proposal could produce perverse results. For

instance, the lack of attention to learners' knowledge and experience and the preoccupation with the minutiae of substantive knowledge that characterize undergraduate teaching may well convey to intending teachers views of subject matter knowledge, teaching, and learning that run contrary to what is essential to good instruction in schools (McDiarmid, Ball, and Anderson, in press).

Conclusion

The proposal to abolish undergraduate degrees in education and require liberal arts majors of all teachers is posited on the assumption that such a reform will improve the academic preparation of teachers. To help learners develop integrated and meaningful understandings of subject matter, teachers need not merely the substantive knowledge of their subject matters but understandings of what specialists in the field do, what constitutes knowledge in the discipline, how knowledge is generated and verified, and how knowledge is best taught and learned. When we look at the evidence on student understanding in liberal arts courses, we find that students frequently do not understand the subject matter in an integrated, conceptual way. These courses may present students with little opportunity to learn in this way.

Teaching at the undergraduate level seems to take little account of the students, treating them as passive recipients of knowledge represented primarily in textbooks and lectures. Certainly, exceptions exist, particularly in laboratory sciences and upper level humanities courses. Few incentives exist for liberal arts faculty to think differently about the teaching and learning of their subject matter. The values that dominate colleges and universities emphasize the freedom of individual faculty to study and teach whatever each believes is important in his or her field, not to consider his or her contribution to students' overall understanding of a field or its relation to other fields of inquiry. In the promotion and tenure system at most institutions, furthermore, teaching takes a back seat to research and writing--a situation many scholars find agreeable.

Changes in the current conceptions of knowledge and in the pedagogy of the liberal arts appear unlikely in the short run. Such conceptions, values, and practices are deeply ingrained in the traditions, culture, and organization of universities and the disciplinary fields. This is, however, a culture that holds inquiry and the fruits of inquiry in the highest regard. A beginning point for a reconsideration of the pedagogy of the liberal arts would be an investigation of what students currently make of their opportunities to learn in all subject matter areas. This requires that we look at both what students have any opportunity to learn about mathematics, history, literature, physics, biology and so on *as well as* what they make of those opportunities.

As noted above, scholars such as Champagne and her colleagues (1985) have done this in mechanics. We need similar investigations across the undergraduate curriculum. In exploring what students learn from their liberal arts courses, we need to go beyond

measuring their substantive knowledge to investigate what they think the subject matter is about, how it is related to other disciplines, how new knowledge is generated and tested, and what those who are in the field do. The evidence derived from such investigations could provide common ground for us to begin a conversation with colleagues in the liberal arts about what students need to know and how they may best learn this.

As adoption of the Holmes Group reform proposal proceeds apace, teacher educators should not be surprised if the hoped-for revolution in teachers' subject matter knowledge and understanding fails to materialize. Changing the way people think about things is difficult under the best of circumstances. In this case, teacher educators must depend on their colleagues in the liberal arts to revise, first, their own views of subject matter, teaching, and learning and, then, help students develop multidimensional understandings of the discipline. If the reforms fail to produce the anticipated changes in teachers' ability to help diverse students develop integrated and meaningful understanding of subject matter, will this undermine important and much-needed efforts to increase teachers' subject matter understanding? At stake may be more than these particular reforms. Policymakers, particularly at the state level, may view the failure of these reforms as evidence that university-based teacher educators are incapable of identifying and transmitting the knowledge and skills they believe teachers' need, as has happened in New Jersey. The effects of these reforms would be perverse, indeed, if they resulted in a further erosion of teacher educators' power to shape and define teacher preparation.

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